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DEPARTMENT OF THE INTERIOR
Hon. Charles Stewart, *Minister* W. W. Cory, C.M.G., *Deputy Minister*
NORTH WEST TERRITORIES AND YUKON BRANCH
O. S. Finnie, *Director*

Preliminary Report

on the

Aerial Mineral Exploration

of

Northern Canada

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1930

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By
G. H. BLANCHET, B.Sc., D.L.S., F.R.G.S.

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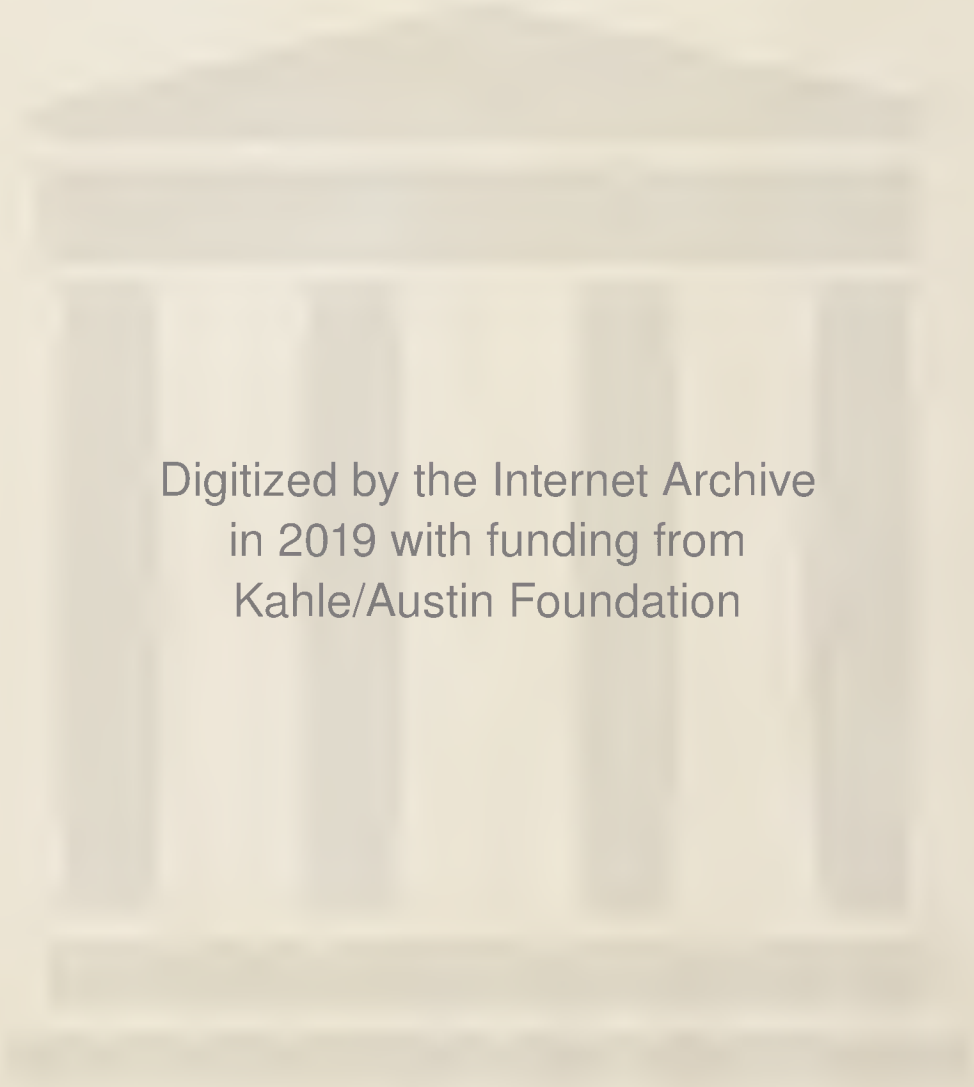

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AERIAL MINERAL EXPLORATION OF NORTHERN CANADA

Introduction

The building of the Hudson Bay railway directed the attention of business men to the regions bordering Hudson bay for the development of which the new railway offered facilities. At the same time keen interest in mining activities in Canada drew attention to certain portions of the Hudson Bay district which previous exploration had found to be favourable for the occurrence of minerals.

Several companies were formed, backed by those interested in mining development in Canada, to undertake mineral investigations in northern Canada, commencing with the Hudson Bay area. These were the Northern Aerial Mineral Exploration, Dominion Explorers Limited, and Cyril Knight Company. The Nipissing Mining Corporation of northern Ontario also sent prospectors into the district. Expeditions were organized on a very large scale. Ships and aeroplanes were purchased. Materials and equipment for elaborate bases were brought to points on Hudson bay and specialists in various fields, aerial, geological, and prospecting were included in the personnel.

The present preliminary report touches briefly on the operations of 1928 and 1929 and on the added knowledge of the country obtained through these activities. The complete report, with maps, will appear in a short time.

Scope of Operations

The area considered lies chiefly in Keewatin District and includes most of it. The west coast of Hudson bay was travelled from Churchill to Repulse bay. Chesterfield inlet and Baker lake were navigated by the largest ship which had traversed them up to this time, and aerial observation was carried on over the greater part of the area. Many observations for latitude and longitude were taken and ground investigations were made at many points.

During 1929, especially in connection with the search for a lost party of the Dominion Explorers, practically all the country between Back river and the Aretie coast, from Pelly lake westward to the upper waters of Burnside river, was flown over and sufficient information was obtained to correct errors respecting the principal features on the map and to determine the general character of the country. It is difficult to realize the vast extent of the country involved. Keewatin District has an area of over 200,000 square miles, about the size of France. The Arctic watershed included covers about 35,000 square miles. Throughout this country, although conditions are severe they are not of a nature to prohibit ordinary community activities, and there are no unsurmountable physical obstacles to overcome in providing for and carrying on developments.

Present Day Methods of Investigation

One of the most interesting aspects of these ventures into the Far North is that, by the use of the aeroplane for transportation and investigation and wireless telegraph for communication, the boundary marking the generally accepted northern limit of resources of present-day interest was swept back a thousand miles into the north; country which had been unknown hitherto or had been seen only by the explorer on his rapid journeys across the country, was carefully

inspected by trained experts from the air and studied in detail on the ground by prospectors fresh from the mining areas of northern Ontario and Quebec.

The idea of aerial investigation for minerals which is a comparatively new one, was given a good practical test. The possibilities and the limitations of the aeroplane in northern Canada were determined by the sound but costly method of practical experience. Never since the time of the "Franklin Search" has so much public attention been directed to northern Canada. Then interest centred chiefly in the Arctic regions and the results were largely geographical. The present interest is in the vast sub-Arctic region—that lying between settlement and the Arctic coast—and although the geographical and topographical results are important, those chiefly studied are the economic possibilities. The expeditions sent out on the Franklin Search were for the most part organized by the British Government, and their objectives were humanitarian or scientific, whereas those of to-day are financed by Canadian business men whose interests are essentially in practical development and financial returns.

It must be recognized that such a rapid survey as is now being carried on cannot be thorough or complete and that the only discoveries considered of interest are what may be termed those of first magnitude. This means that, from the point of view of minerals alone, only those will be found that are fairly obvious and of these only such as are of large extent or great richness will be considered. However, if developments are undertaken, mines opened up and railways or other means of transportation provided, more intensive investigation will at once be stimulated with the possibility of the discovery of new resources. Those of secondary importance could then be developed.

Aerial Prospecting

The aeroplane first came into use in connection with prospecting for minerals in the Red Lake area of northern Ontario and the Rouyn field of northern Quebec. Its earlier application was chiefly for transport,—to reach points difficult of access quickly and easily. Prospectors and geologists flying across the country found that the aerial view was of great assistance in their ground work. Rock exposures can be readily located and the general character of the rock can be ascertained from the appearance of the weathered surface. Sedimentary rocks can be distinguished from igneous and light basic rocks from the dark acid ones. It can be noted if the formations have been disturbed by igneous intrusions or by structural bending and folding. On the ground it may be a difficult matter to trace the course of an intrusive dyke while from the air it usually stands out as an unmistakable line across the country with characteristic topography and vegetation.

When aerial photographs are available, especially verticals which can be studied in relief with the stereoscope, the country may be broadly classified as "promising" or "unpromising" for the occurrence of minerals. The most useful function of the aeroplane in this connection is that of carrying a trained observer-geologist about the country, or of permitting the taking of photographs which may be studied by one. He is able to eliminate those portions of the country in which there are no rock exposures, or in which they are unfavourable for the occurrence of minerals, and to select promising areas. For this method to be sound it is necessary that the observer should be familiar with the local ground conditions and that he should be experienced in aerial work. There are certain definite signs of minerals that may be observed from the air, chiefly what is known as "gossan cap" or a rusty brown stain of iron which may be associated with copper and nickle. However, more often the aerial observation reveals only general indications of formation and structure, suggesting the presence or lack of mineralization.

The next operation is to transport a ground party with supplies and equipment to study those areas selected as promising. Here again the aeroplane plays a useful part in placing the party quickly at any point within its range and providing local transport as required. Should the area prove interesting more men can be brought in, while, on the other hand, if nothing of value is found the party can be moved to another selected area.

The aeroplane can be used to a limited extent for one stage more. The tools and equipment necessary for the preliminary investigation of a mineral find can be moved in by it and service maintained until a fair estimate can be made of the discovery. Aeroplanes had been used for transport and observation in the mining districts mentioned, to a somewhat limited extent, previous to 1928 and both the executives and the field men of the mining interests had been satisfied with the services which they could render. When the possibilities of examining northern Canada for minerals came to be considered the questions as to the difficulties that would formerly have been prohibitive, such as inaccessibility, the vastness of the country and the short season of operation, were all met by the common answer—the aeroplane.

THE AEROPLANE FURNISHES DIRECT CONTACT BETWEEN THE BUSINESS MAN AND HIS FIELD OF INTEREST

The arrival at a far northern base of company officials on an inspection tour.

It was a radical step from using aeroplanes as an accessory for prospecting to basing the plans of elaborate expeditions on them. Another important factor entered into the extensive use of aeroplanes in northern Canada. It was a new field and one in which aerial problems had not been studied and it was known that these were of a serious nature. Three important matters were to be studied and tested in the course of these investigations in northern Canada: (1) the mineral possibilities of the country were to be looked into; (2) the suitability of the aeroplane for such investigations was to be put to a severe test; and (3) the conditions to be met in flying in the north were to be learned by practical experience. All these matters have an importance beyond the material results which the supporters of the expeditions may secure, and the experience of the last two years has shown that this knowledge has been obtained at a high price of money and effort.

Work based on the extensive use of aeroplanes requires elaborate organization. The type of plane must be carefully selected and orders sent in a long time in advance of the required delivery. Gasolene bases must be established under the

difficulties of northern transportation and as far as possible spare parts and equipment must be carried to effect repairs in the field. At every turn practical difficulties are met which complicate the theoretical problem. There is a period in the spring and fall during which pontoons must be used in the south while skiis are required in the north. Conditions for mooring and landing are difficult on account of high tides, storms and lack of land shelter. Then, too, the magnetic compass becomes first sluggish, and then useless, on account of the proximity to the north magnetic pole and conditions peculiar to the position of the compass in the aeroplane. The substitution of the solar compass is only a partial solution as it requires comparatively clear skies. Other substitutions for the magnetic compass are too heavy to be suitable. The last resource for navigation—travelling by landmark—is not often feasible on account of incompleteness and inaccuracies of the map. Pilots are frequently faced by the difficult problem of travelling across country without a compass, without the sun and almost without a map. A good instinct for location and a retentive memory are essential qualifications for a pilot in northern Canada.

When all the other difficulties and dangers of flying in the North have been considered and more or less solved, there remains one that is the most baffling and feared by all who have experienced it. That is the condition of low misty clouds that hang over much of the country during the spring and fall. They are seldom more than 1,000 feet high, usually not more than 200 feet, and often have trailing curtains down to the ground. A river may be followed even when the mists are very low. It serves as a guide for navigation, a possible forced landing place, and a safe passage among mist-shrouded hills. Lacking a waterway to follow when the mist is low, flying becomes dangerous or impossible. It is very often the case that above the comparatively thin stratum of low misty clouds the sky is clear or lightly clouded at a great height. It might reasonably be suggested that on long flights the plane should fly above the mist. This would be quite feasible if before leaving a station, or with the plane wireless, it could be ascertained that a certain point along the route, not too distant, was clear of the misty condition. Also to have a reasonable factor of safety the plane should be of the tri-motor type to minimize the danger of forced landings through engine trouble, because a landing through the mist is dangerous. The pilot never knows how near the ground the mist may reach or what is the nature of the country beneath it. It is essential that this problem of spring and fall mist, one of the most difficult, with which the Arctic aerial pilot has to deal, should be taken into account in planning all flying operations in the Far North.

The organization for aerial investigation includes essentially the following personnel:—

Aerial; one pilot and mechanic for each plane.

Ground; these parties comprise two prospectors each.

Each Operation; one geologist-observer.

Base; one officer in charge directing the work and keeping records, a cook and native casual labour.

One aeroplane can service three ground parties if scattered and more if the parties are concentrated in one locality. There should always be at least two planes working from a base, one supporting the other but not necessarily working together.

Hudson Bay Operations 1928 and 1929

The immediate objective of the mining interests was to prospect that portion of Keewatin District lying south of Chesterfield inlet and also that in the vicinity of Baker lake. This includes an area of over 100,000 square miles. It is unusually well furnished with waterways. In addition to Hudson bay, which washes the east side, the principal of these are: Chesterfield inlet, Baker lake, and the Thelon, Ferguson, Kazan, and Dubawnt rivers. The existence of

these rivers accounts for the fact that the area was known in some detail. They had furnished the highways for Mr. J. B. Tyrrell in his explorations in this part of the country. From his track surveys the main topography had been determined and from his observations in passing along the rivers the nature of the rocks and general geology had been ascertained. Tyrrell reported a geological formation favourable for the occurrence of minerals and noted promising indications at various points. The general situation was reported to be similar to mineralized areas of northern Ontario and Quebec.

On account of transportation facilities, the Hudson Bay coast was of first interest and drew the first attention. Four independent expeditions joined in something of a race to examine reputed mineralized sections of the coast between Eskimo Point and Chesterfield. They present an interesting range from the old to the new in methods of operation. The Nipissing Mining Corporation sent canoe parties, one by way of Great Slave lake and Thelon river and another to

SCHOONER *MORSO* OWNED BY DOMINION EXPLORERS

The *"Morso"* sailed up Chesterfield inlet and crossed to the west end of Baker lake proving that these waters are navigable for craft of fair tonnage.

the end of steel on the Hudson Bay railway, thence to Churchill and northerly along the coast. A second expedition, sent by the Cyril Knight Co., also used canoes but made use of aeroplanes to visit their parties. Northern Aerial Mineral Explorations (N.A.M.E.) equipped a ship, the *Patrick* and *Michael,* at Saint John, N.B., with supplies and prospectors to establish bases at various points about Hudson and James bays, and up Chesterfield inlet. The expedition was later joined by aeroplanes. The fourth expedition, that of Dominion Explorers, also purchased and outfitted a ship, the *Morso,* and sent her from Halifax, N.S., to Hudson bay with men and supplies to establish a main base at a central point of the coast between Eskimo Point and Chesterfield and a secondary base at the west end of Baker lake. Aeroplanes were carried on the ship and others joined her at the Hudson Bay base. As all wished to obtain the advantages of priority a certain amount of secrecy was maintained about their movements and all endeavoured to reach the field of operations as early as northern ice conditions would permit.

Viewed broadly, it was an extremely interesting adventure into northern Canada. Early summer saw the two ships—schooners with auxiliary oil burn-

ing engines—receiving their final overhauling to prepare them for ice conditions on their northern journey. Their oddly assorted cargoes included everything needed for life and work in the North, ranging from aeroplanes to coal and lumber, and from food to needles and thread. Finally in early July they left their maritime ports and headed into the North. At the same time, by Great Slave lake and Churchill river, canoes were working their way through the last ice and across the portages of the height of land and aeroplanes were moving out to advanced bases, waiting for open water in Hudson bay.

Fortunately the season was an early one. The ships sailed through a clear sea in Hudson strait in the latter part of July and equally favourable conditions were experienced in the inland lakes and rivers and in Hudson bay where

UNLOADING CARGO AT TAVANE.

It is a difficult matter to find a suitable harbour in the reef-filled waters of the Hudson bay west coast. Cargoes must be lightered ashore at high tide.

the ice cleared from the shores towards the end of June. However, it was nearly a month later before prospecting operations were under way along the Hudson Bay coast. The lesson was brought home that by ship you can only prepare for the following season; by canoe almost the entire season is spent on the trip in and out; and only from established bases, and largely by the use of aeroplanes can full advantage be taken of the short summer season on work involving extensive travel. For such work it was found that the season was ended in the latter part of September by the freeze-up of the inland lakes.

During the season of 1928 a considerable portion of the coast was investigated by the various parties and although mineralization was noted at a number of points the occurrences were small and usually unimportant. A small deposit of gold was staked at Term point by the Nipissing party and pyrrhotite of some promise on the north shore of Rankin inlet by the Cyril Knight Company representatives. This season was largely one of preparation, establishing bases, working out methods and training men for the work and for the country.

The schooner *Patrick* and *Michael* was wrecked at the entrance to Baker lake and though most of her cargo was salvaged it was impossible for the N.A.M.E. to carry out their original plans for a base at Baker lake. An establishment was made however at the old Royal Canadian Mounted Police bar-

racks near the point where the wreck occurred and a wireless station was set up at the Hudson's Bay Company post at Baker lake.

Dominion Explorers established an elaborate base at a point ten miles north of Ferguson river, to which the name Tavane was given. Here, in addition to living quarters and warehouses, "nose hangars" for the planes were erected. A short-wave, five hundred watt, wireless station was set up and maintained

TAVANE, DOMINION EXPLORERS' BASE ON HUDSON BAY
Winter quarters in the Far North must be substantially built to withstand the heavy winter gales.

TAVANE IN LATE WINTER
In winter the drifts formed about the buildings and offered some protection from the wind.

direct communication with the Department of Marine and Fisheries station at Ottawa. Supplies and equipment were also brought to Baker lake by the company's ship for a secondary base there. The ship then returned to Halifax.

The various parties were moved out in the fall, chiefly by aeroplane, except those remaining to winter at the N.A.M.E. base at Baker lake and the Dominion Explorers base at Tavane. During the winter and spring some explorations were made from Tavane, portions of the coast were surveyed and positions were established by observation. A flight by two Dominion Explorers' planes was projected in the late winter up the Hudson Bay coast and across from Baker

EXPERIMENT WITH A TRACTOR

This trip was from Churchill northward along the sea ice. By including a caboose, such operations are almost independent of weather and may be carried on in comparative comfort.

lake to the Arctic. Winter conditions proved to be too severe for the type of planes used and navigation was extremely difficult across the snow-covered lakes and plains, which offered few landmarks for guidance. After proceeding as far as Baker lake the trip was abandoned but through it valuable data was obtained on winter flying conditions in the North.

An interesting experiment was tried in the late winter by Dominion Explorers in the use of tractors on the fixed shore ice of Hudson bay. The Department of Railways and Canals had been successful in using them, moving freight from Nelson to Churchill and from the end of steel on the Hudson Bay railway to Churchill. The Hudson's Bay Company had experimented with several types of tractors in attempting to open up a winter route from Wager inlet to the eastern Arctic at Cockburn bay. However not much data was available

PLOUGHING A ROAD THROUGH THE DRIFTS

It is probable that a tractor that could ride over the drifts would be more successful.

and though the best advice was taken as to the most suitable kinds of tractor and the general handling of the operation, conditions were met north of Churchill quite different from those to the south. These caused serious delays and demonstrated that modifications in the standard equipment would be necessary for successful operation. The tractors were sold to the Hudson's Bay Company, who propose transporting freight to some of their inland posts by them in winter instead of by canoe, as formerly.

The idea of using tractors to move freight along the shore ice of Hudson bay and the Arctic and for certain inland transportation, especially in the treeless portion of the Northern Plains, is one of considerable interest. By them, advantage can be taken of the favourable conditions of spring and early winter and inland points can be reached that are difficult of access by any other means, especially if any large volume of freight has to be moved. It is only by such pioneering efforts that the most suitable type of tractor may be selected and the most favourable season determined.

All planned to place their men in the field as soon as spring conditions made such work effective. To be in a position to do so necessitated flying the prospectors in. Men and aeroplanes gathered at Churchill towards the end of April and advantage was taken of all favourable flying weather to move the men to various bases. Here again it was necessary to pioneer unknown conditions—spring flying. Theoretically this season should be favourable for flying. The days are long, the weather mild and it was thought the melting of the snow would improve landing conditions. However a serious difficulty was introduced by the spring mists which hung over the land during the most of May. The situation improved in June in which month there is usually some of the best working weather of the year, but an interruption occurred again towards the end of the month when the ice became unsafe and before open water permitted the use of pontoons. As soon as possible the various parties started work. The Nipissing Company's party commenced development work at their gold find on Term point. Cyril Knight Company's party moved to their Rankin inlet pyrrhotite-copper location and did some cross-sectioning by trenching.

Both N.A.M.E. and Dominion Explorers carried on as active aerial investigation and prospecting as weather and general conditions would permit. Ground parties were located all the way from Padlei on the south to Repulse bay on the north and from the Hudson Bay coast to Kazan and Thelon rivers. Misadventures interrupted work and upset plans. An N.A.M.E. plane was forced down out of gas near the Arctic coast and the party was found only after some weeks' searching. With Dominion Explorers a series of unfortunate engine failures tied up planes and hampered the work. However, through the various operations the coastal examination of the previous season was continued till it extended from Eskimo point to Repulse bay, including Wagner inlet. Investigations extended inland a distance of one hundred to three hundred miles. This includes a broad stretch of the low lying coastal plain south of Chesterfield inlet in which rock exposures are relatively of small extent and the more rugged country to the north which was found to be largely unpromising granites and gneisses.

In the latter part of the season two N.A.M.E. planes crossed from Baker Lake to Bathurst Inlet. Investigations were made along the Arctic coast westward to the Coppermine river and a return was made to Winnipeg by way of Great Bear lake and Mackenzie river. A similar expedition was planned by Dominion Explorers which was to combine a general inspection of the company's bases in northern Canada with certain operations including bringing out their prospectors from Coppermine river. A series of misadventures caused delays and finally forced the party down on the Arctic coast with insufficient gasolene to reach their nearest base. They were obliged to wait until ice formed on Dease strait before they could reach supplies and communications at Cambridge Bay. During the searching operations, carried on by aeroplane, much of the Arctic

coastal plain was flown over and interesting geological and topographical explorations were made.

No new finds of importance were made during this season's work in the Hudson Bay area. The country examined had been reported to be favourable for mineral occurrence and a number of reported discoveries had been made in the past. As a result of two years' prospecting during which a large portion of Keewatin District was examined from the air and studied at selected points on the ground, it was found that where the exposed rock was of a character that might lead to the expectation of mineral deposits; the lack of intrusive bodies and structural disturbances discouraged the hope of finding anything of importance. On the other hand, it must be remembered that the greater portion of the country rock is covered with a mantle of drift and that mineralized glacial boulders which have been transported easterly are found in many places, proving the existence of ore bodies in the interior.

DIFFICULTIES AND DELAY WERE CAUSED DURING FORMATION AND BREAK-UP OF THE ICE

The limitations placed on operations by both pontoons and skiis may be overcome by the use of land gear of special design.

From the point of view of the mining interests that undertook the investigation of this area the results of the work of these two seasons must be considered negative. They were concerned only with major deposits and in the superficial (but in general sufficient) examinations made, none was found or indicated and the ground work supported the conclusions of the aerial observers. It would be unsound to conclude that the country is worthless from a mining point of view but to discover minerals will require more intensive study, especially in the drift-covered areas.

Other Operations in the Northwest Territories

During 1928, in addition to investigations in the Hudson Bay country, a base was established by Dominion Explorers at the east end of lake Athabaska and prospecting was carried on by them in the portion of northern Saskatchewan adjacent to it, and N.A.M.E. sent planes to various points in Mackenzie valley.

In 1929, operations in the west included a thorough investigation of a large portion of northern Saskatchewan and aerial and ground investigation of certain selected localities in the lower Mackenzie River country, Great Bear Lake and Coppermine River areas. Gasolene bases were established by both companies

at points along the Arctic coast and Dominion Explorers established bases at the mouth of Burnside river on Bathurst inlet and near old Fort Reliance at the east end of Great Slave lake. These bases and gasolene caches were in preparation for a continuation of the systematic mineral exploration of northern Canada, to include the Arctic coast and the country eastward from the Mackenzie system, to join up with the work already done. Dominion Explorers' bases at Tavane, Baker Lake, Bathurst, Reliance and Stony Rapids are equipped with wireless, which maintain schedules among themselves and with the outside through stations of the departments of Marine and Fisheries and National Defence. These stations are well situated to offer general service should developments take place.

Interesting results have been obtained already in the western field and there is considerable promise that in the vast area of the "height of land" country, which includes the western border of the "Canadian Shield," major mineral deposits will be found. The lead-zinc deposits near Resolution on Great

FLYING OPERATIONS--INNUMERABLE LAKES ARE DOTTED OVER THE COUNTRY

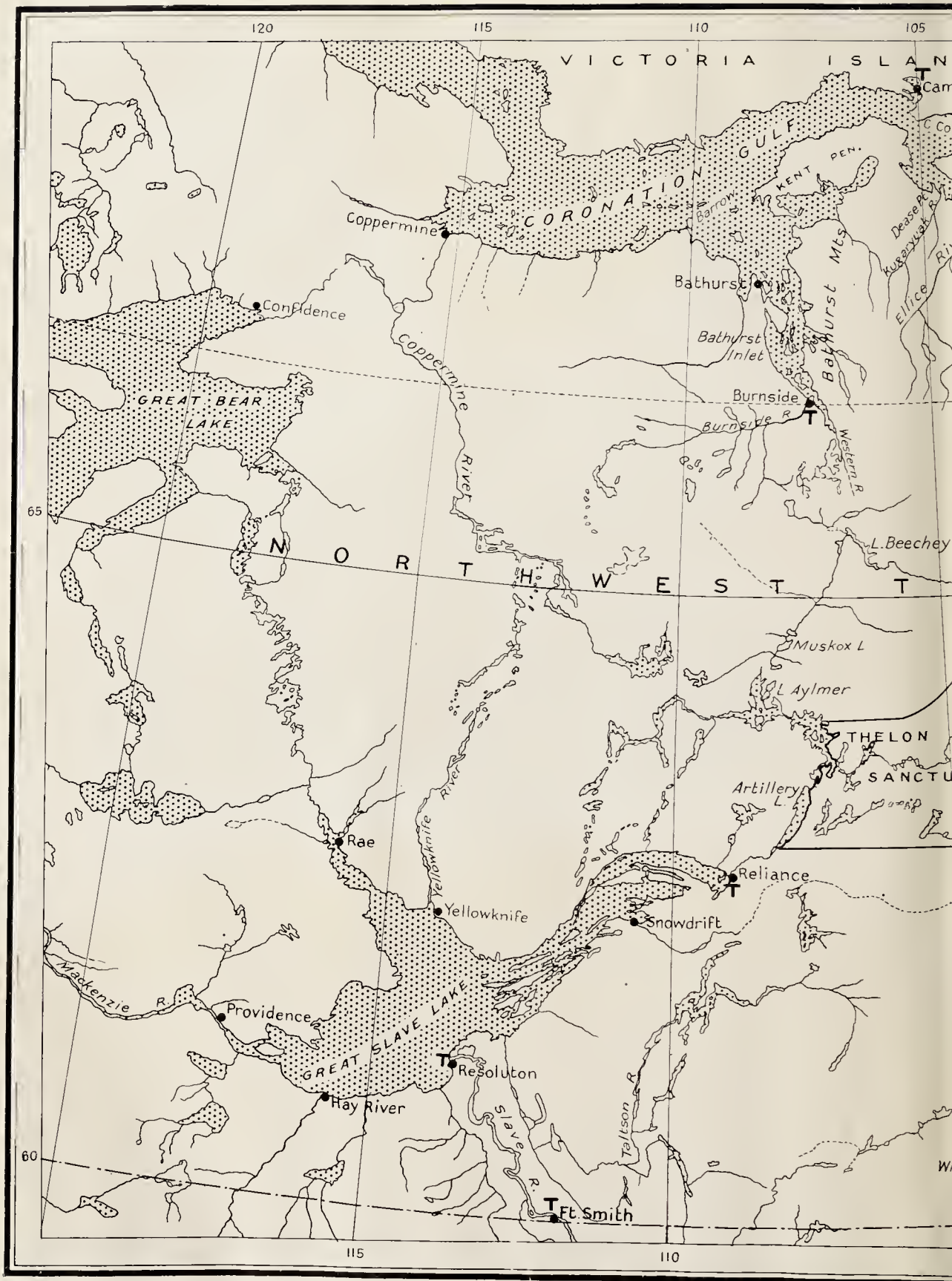
Cross-country navigation is extremely difficult. The waterways are largely made up of lakes which are scarcely distinguishable among the confusing waters.

Slave lake, which were staked many years ago, have assumed considerable importance and further investigation has revealed larger ore bodies there than were known formerly.

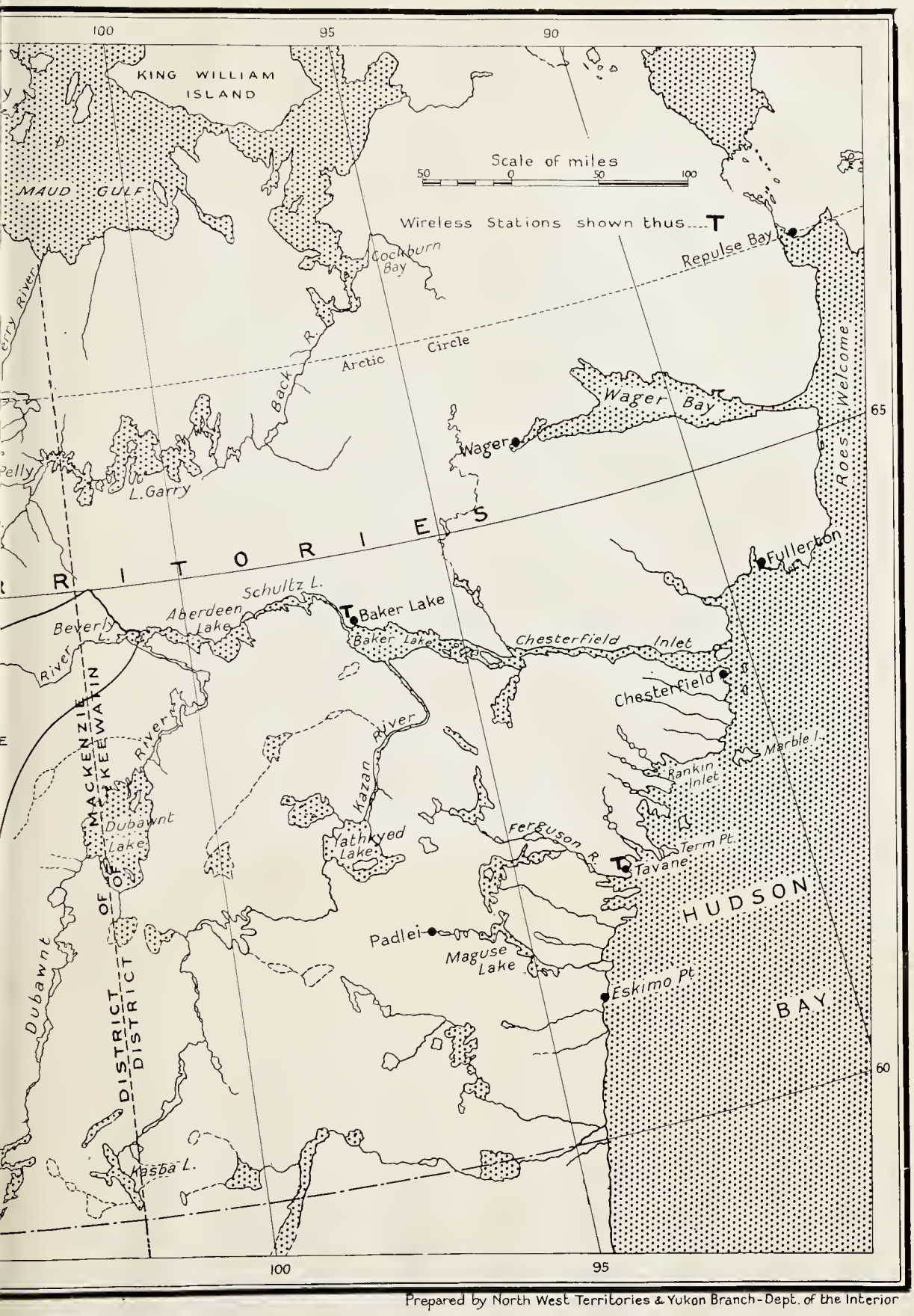
General Conclusions from the 1928-1929 Mineral Explorations

It is the general opinion of those who have been engaged in these operations that the west coast of Hudson bay does not contain ore deposits of sufficient importance to be of present day interest. N.A.M.E. have abandoned their base and withdrawn their men. Dominion Explorers sold most of their buildings and equipment at Tavane to the Hudson's Bay Company and Revillon Freres. Baker Lake base is still retained as a link in their chain of communication and aerial activity but the company have withdrawn all personnel except the wireless operator. On the other hand the promise of discoveries made and formations found in Mackenzie District point to that as being the field of chief interest.

Although the results of the mineral exploration of the west coast of Hudson bay have been unpromising, much useful information has been gathered on the country, the climate, the natives, and wild life.



MAP SHOWING AREA



Prepared by North West Territories & Yukon Branch - Dept. of the Interior

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Mapping and Topography

MAPPING

When attention is directed to a new country one of the first considerations is that of maps. What are its land features and its travel routes? Prior to the advent of the aeroplane into northern Canada the country had been crossed by a number of long lines of exploration, following waterways which were roughly mapped. These were practically the only topographical features shown on the map but were sufficient guides for other expeditions in finding their way across the country. With the arrival of the aeroplane a new difficulty at once arose. The extensive view of the country obtained at a high altitude shows, in addition to the waterways of the map, innumerable lakes on both sides. The simple system of lakes and connecting rivers as mapped by the canoe track survey is difficult to recognize in the maze of lakes and streams.

However, in the hands of a capable navigator they furnish quite sufficient information for following the route. He picks up the courses actually followed

AN AERIAL TRACK SURVEY

Whenever possible a landing was made about noon to fix the position by sextant observations.

in the track survey and is not concerned with unmapped bays and islands and inaccuracies of shore line. The important point is that by following the waterway he can arrive at some predetermined locality and he will know his approximate position at all times along the way. Once he leaves the route he must travel and hold position by dead reckoning. It would be impossible to attempt to map completely such a tremendous area and be able to meet present day mapping requirements. What is needed is a map showing the main waterways, any pronounced features that will serve as landmarks, and approximate sketches of secondary features, showing especially the direction of drainage.

Mapping by aerial photography is an operation by itself and cannot be done in connection with other work, though photographs, even those taken with a hand camera, assist sketching. The best results, it was found, were obtained by the adaptation of the track survey methods. Sketches were made of connected waterways with as much detail and accuracy as possible and as many points were fixed in position by observation as circumstances permitted. In addition, running notes were kept on the country, classing it as: (1) flat coastal plain, many ponds, few large lakes; (2) drift-covered plain of moderate relief with occasional large lakes; and so forth. Areas of rough high

land were particularly noted. Elevations were read by aneroid whenever possible and the heights of hills above country level were estimated. In general, while flying about the country at an elevation of 2,000 to 4,000 feet and at a speed of two miles a minute, a broad view spreads before the observer. Certain information was found to be of most assistance both for flying and ground investigation and as much of this as possible was recorded. From this information maps will be corrected and new ones prepared. To meet present mapping requirements, an abundance of general information is more desirable than precision.

KAZAN RIVER AND A POSSIBLE WATERPOWER PROPOSITION
The stretches between the lakes of the larger rivers contain many waterpowers.

TOPOGRAPHY

There is a wide strip of country bordering Hudson bay on the west that was formerly covered by the sea. The land evidently rose slowly, approximately five hundred feet. Periods of pause are marked by old coast lines and all depressions are filled with water. Due to local conditions, the flatness of the country, the bouldery nature of the drift cover and the long winter—drainage systems have scarcely developed. Surface water gathers in the depressions in lakes which spill uncertainly from one to another. In the interior, south of Chesterfield and Thelon river, drainage follows a NNE course while on the coastal strip it is easterly.

The confusion of waters as noted on the ground is observed from the air to conform to a clearly marked trend of topography. This is the result of glacial movement which held a course of about 30° south of east and has given the country, when viewed broadly from a height, the furrowed appearance of a plowed field with shallow depressions and low hills. The lakes occupy the furrows. Where they are confined between adjacent ridges they are usually small and regular, but where they gather sufficient water to fill the furrow and burst through into adjoining ones, they produce extremely complicated bodies of water with the ridges forming points and islands and the depressions, bays and connecting lakes. In the case of large lakes the confusion of land and water renders mapping very difficult. The overflow from the lake often finds some obscure break in the hills and discharges along the shallow valleys or

through the broken ridges until the next lake basin is reached. Such are the rivers of the Hudson Bay coastal plain. In the case of Dubawnt and Kazan rivers which flow in a northeasterly direction, practically at right angles to the trend of topography, the river stretches are much broken by rapids where they cut through the ridges.

THE NORTHERN PLAINS IN SUMMER

The well-watered lowlands support an abundant vegetation which is enlivened by the bloom of many flowers.

A GRASSY VALLEY AMONG LOW ROCKY HILLS

Such valleys are resorted to by the caribou for food and shelter. In addition to the grass of the valleys, mosses and lichens grow on the hills.

It is extremely interesting to fly over a river such as the Dubawnt, which was mapped from a canoe track survey (Tyrell, 1893). The casual observer would be inclined to criticize the inaccurracies of form and detail. The comparatively simple outlines of the map seem to bear little resemblance to the actual. Unmapped bays completely change the shorelines and the masses of islands render difficult the recognition of them. However, to the practised eye, through the confusion stretches the line of canoe travel with the features observable from it clearly shown. The course actually travelled and surveyed is accurate and the important features along it are easily identified, but the sketching done from the canoe course of distant shore lines is necessarily incomplete ar l

inaccurate. The safest cross-country routes are along the waterways mapped by exploratory surveys.

Though in general the country has a gentle slope and moderate relief and the hills are chiefly moraines and eskers of glacial origin, occasional island-like rocky areas break through the drift cover. These are most numerous either near the coast or far inland and appear to represent islands of the former sea and ancient coast lines.

Country North of Chesterfield Inlet.—Chesterfield inlet, Baker lake and Thelon river mark an east-and-west line across the country of topographical significance. An upland area of varying height and roughness lies to the north of it, extending eastward to Hudson bay and forms the south shore of Wager inlet. It forms the divide between Thelon and Back rivers. The westerly portion of the height of land is chiefly drift-covered country with long slopes and rounded outlines, but as you proceed eastward it becomes higher with rough, broken, rocky country.

THE LAKES DISCHARGE UNCERTAINLY FROM ONE TO ANOTHER

A lake may have several such outlets leading towards different waters.

The Arctic Slope.—Back river flows easterly across the country north of the height-of-land uplands, finally turning north to the Arctic ocean. Through much of its course it crosses an extensive sandy plain with lake expansions. Northward from Back river the country has somewhat the same general character until at the head waters of Ellice river a rough, rocky country with marked relief is found. Westward the country rises until the Bathurst "mountains" are reached which comprise rugged ranges of hills rising to 1,500 feet, in which the formations are much broken and folded. The mountains have an average width of about fifteen miles from Bathurst inlet and form its east coast. They start at the neck of Kent peninsula and follow the curving sweep of the coast. South of the inlet they merge into the rough rolling country. The west coast of Bathurst inlet is also high and rugged but inland it is less broken and assumes the character of a high hilly plateau.

The rivers draining the country north of Back river are unlike those of the Hudson Bay coastal plain. They rise in large interior lakes with many headwater branches but in descending they have well defined beds and hold fairly direct courses. Few lakes of importance occur along their lower courses.

The Hudson Bay Coast.—The general outlines of the west coast of Hudson bay were originally determined chiefly from ships holding well out to sea. These were corrected to some extent by various track surveys made in smaller crafts following inside waters but even in these it is impossible to follow the intricacies of the coast or to fix the actual shore line on the extensive tidal flats. Consequently there are inaccuracies of position, chiefly in longitude and the detail as shown is little better than a sketch. To view the coast from a safe distance outside its shoals and reefs it presents a view of a few low hills and ridges broken by gaps of uncertainty. When travelling more closely along it by canoe or whale-boat the coast stretches away in a confusion of bays and headlands, islands and shoals, which constantly change as the tide rises and falls. It is only

SURFACE CONDITIONS OF THE SNOW ON THE OPEN PLAINS

The snow is packed so hard that it is scarcely marked in walking over it and the surface is roughened, being whipped into wave-like drifts.

from the air that a true conception of its details can be obtained. From an aeroplane it can be seen that the low points are continued into the sea in islands and reefs and the shallow bays become tidal flats at low water and almost merge into coastal lakes.

Instead of a coast line it has a coastal area of island- and reef-filled waters which varies materially with each change of tide. South of Dawson inlet the flat, featureless land merges into the shallow sea in an almost straight line. Between Dawson and Chesterfield inlets the local topography is submerged in a major one, of the large bays and inlets of this portion of the coast.

Northward from Chesterfield the country is higher and has more marked relief and the coast-line is locally extremely irregular. From above it has the appearance of a frayed piece of fabric. The bordering waters are shallow and full of reefs.

Climate

There is often a misconception regarding the climate of northern continental Canada. Information on it is taken more from narratives of adventure and highly coloured newspaper reports than from the records of those who have observed and recorded it. There are a number of stations along the Arctic coast and about Hudson bay where trading and other activities are

carried on and at these the ordinary activities of life are carried on without undue discomfort throughout the year.

The mean winter temperature is low and winters are long, but the eold is seldom extreme. Storms aeeompanied by high wind sweep aeross the eountry periodically and present the same dangers as did the blizzards of the western prairies in the early days of settlement. It is neeessary to take shelter and to have suitable elothing. On the other hand the winter is a season of elear skies and, as the sun eomes baek, of fine bright days. The temperature elimbs above zero to stay about the middle of April and the snow disappears by evaporation direetly into the air rather than by melting to surfaee water. This gives rise to the misty atmosphere of the season. In June the

ROUGH TIDAL ICE

Each boulder on the beach raises the ice above it into rough piled-up masses, sometimes twenty feet high. As the ice melts in the spring it is found that most of the boulders have been lifted and are on top of the ice. Some of them drop back through holes but many are carried away with the ice.

land begins to show, first on the hill tops and then on the plains patehes appear, whieh spread until only the big drifts remain. Iee melts on the small, shallow ponds first, then, as the water rises in the lakes and lifts the ice, it soon "eandles" and breaks up. The sea iee melts above and below. Holes and eracks widen and it is finally earried away in large fields by an off-shore wind in late June or early July.

During July the new growth on the land is very rapid. The eountry changes from brown to green and for a few weeks it is enlivened by a multitude of brightly eoloured flowers. Many varieties of land and shore birds eome north for the nesting period and their animation and songs relieve this season from the stillness that throughout mueh of the year rests on the land. By the middle of August all growth is reaehing maturity and the eountry is assuming the brown eolour of its ripened vegetation. Usually in early September the first frosts turn the leaves of many of the shrubs to erimson. Iee starts to form on the ponds and oeeasional snow-flurries drive down from the north. The ehangeable light winds of summer settle into the northwest and beeome stronger. From the middle of September until the latter part of October the sky is obscured mueh of the time by low misty elouds. By this time iee has set in all the inland lakes and the land is lightly eovered with snow.

With the freeze-up, the mists disappear or become local to the open water in the sea or in the very large lakes. November is usually a fine, bright month, moderately cold, and for the most part free from high winds. Winter comes in earnest in December when the thermometer drops to its mean winter level of about 20° F. below zero, with small variations from day to day or during the day. At the Hudson Bay base of Dominion Explorers daily records were kept and sent to the Department of Marine and Fisheries, Ottawa, by wireless. The lowest temperature recorded during the winter was 45° F. below zero, and it remained below zero until the middle of April.

Storms average about two a month and usually last three days. They are so consistently from the northwest that the drifts formed by them may be safely used as guides for travel in thick weather. A strong wind raises the dry, powdery snow into a driving scud, similar to a sand storm in a desert, and travel is impossible. Otherwise the winter season is a pleasant one for work and travel. In general life in established communities may be carried on throughout the year with few restrictions and with little hardship. The season of growth with its many hours of sunlight permits a large variety of shrubs, flowers, and grasses to mature.

Soil and Vegetation

The surface cover in the open plains is of certain characteristics types:—

(1) Exposed rock;
(2) Coarse glacial drift, boulders, sand and gravel;
(3) Sand plains;
(4) Lowlands on which some finer materials have accumulated.

The soil is all glacial debris with some assortment in places and some secondary enrichment in others. The ridges are usually comprised of coarser materials which do not retain moisture and the lowlands, where the finer materials have gathered, are often swampy. Rainfall is comparatively light and the coarse soil of the uplands supports only hardy types of vegetation, but on the well watered valleys and on the swampy flats there is a varied and abundant growth of grasses and shrubs. They are prairies with a character peculiar to their northern latitudes.

An interesting illustration of the potentialities of the sandy soil of the ridges is that where this has been worked over in the burrowing of the ground squirrels there is a luxurious growth of hay. The ground squirrels are the first farmers of the sub-Arctic plains. Their activities make the soil productive and when their hay crop has ripened to maturity they cut it down and carry it to their underground stores houses. The quick growth and maturing of the hay demonstrates the suitability of both soil and climate for certain types of vegetation.

The northern portion of the Hudson Bay slope is practically destitute of tree growth. A dwarf ground willow is scattered about here and there on the swampy plains but is seldom more than a few inches high. The spillways from the lakes are usually spread over a considerable area in many small channels and are marked by a tangled growth of willow flattened against the boulders. On the Arctic coast the growth of willows on swampy ground is quite well developed and more widely spread.

Flying across the country south or west towards the woodlands, the character of the borderland can be clearly seen. The vegetation of the valleys and of the margins of the lakes and rivers becomes more abundant and more sturdy. Trees begin to make their appearance in the sheltered places, first in small clumps, then they become more continuous, until the occasional timbered valley changes to scattered bare hill tops and finally the forest covers hill and valley alike. It is the matter of abundant moisture that favours the heavy growth of vegetation farthest out into the open plains and that of shelter

which permits the first development of tree types, first black spruce and tamarack, then birch, jack pine and occasional clumps of white spruce and finally poplar.

Wild Life

In the course of the various flying operations opportunities occurred to observe the caribou migration in various parts of the country at the same season and for the first time to get a comprehensive picture. It was previously difficult to determine what the movements actually were and whether the herds noted by various observers were distinct or the same ones in different stages of their migration. It is still impossible to form an estimate of their number but, to correct unsound generalities such as "countless numbers" and

THE TUPEK OR CARIBOU SKIN TENT

Canvas tents are now largely used but when necessary the natives can always provide adequate shelter from what the country offers.

"the vanishing caribou," there are probably in the order of two to three millions, exclusive of those on the Arctic islands. The herds are lost in the vastness of the country which could support much larger numbers. Good range land exists everywhere and there are many natural sanctuaries and they are only exposed to ravages of their enemies, man and the wolf, at certain seasons. It is probable that in those localities in which they are becoming scarce the fact is that they avoid those places which they find to be dangerous.

The natives of the southern portion of the west coast of Hudson bay are essentially inland people, depending on the caribou through much of the year for food and entirely for winter clothing. There appear to be local herds ranging between Churchill and Baker lake which the Eskimos still meet at certain seasons at traditional gathering points. This country is favourable as a caribou range and the animals are comparatively unmolested. It is probable that they have changed little in number or habitat. The migration from the northeast which passes north of Baker lake and reaches the upper Dubawnt river is less known. Recently they have been avoiding Baker lake and hardship has resulted to the

natives here but in flying over the country to the north they were observed in great numbers and later a steady movement was noted crossing at Aberdeen and Beverly lakes. These were chiefly cows and young, while at the same time large bands of bulls were seen to the south. They probably unite and range in the country northeast of lake Athabasca.

A much larger migration was noted passing about the east end of Great Slave lake about the same time which is probably that seen by a number of observers there. At the time caribou were seen moving in a general trend towards the woods there were practically none in the Aretic coastal plains north of Baek river. If these points can be established from the observations of those flying over the country it will be of great assistance to the natives in directing their seasonal movements and in preventing the severe suffering during periods of migrational change.

THE ESKIMO IGLOO
In devising this winter habitation the Eskimo showed great ingenuity and in constructing it he reveals great skill and patience.

Next to caribou the most important animal in the economic life of the natives is the white fox. Fox skins are practically their only means of purchase and values are set as "so many foxes." This varies with the value of the fox at the time. The white fox is prolifie, a litter may contain ten, fifteen or even twenty. They live ehiefly on mice, marmot and ptarmigan when inland and anything the sea offers when on the coast. There are fairly regular cycles of three to five years of increase and deerease in their numbers. It is probable that when they are numerous and food is searce they prey on one another and many are carried out to sea on the floe iee. They are easily trapped. The natives kill walrus at various points and leave them on the shore to attract the foxes and later set their traps about them.

Other fur is unimportant. An oceasional otter or mink finds its way out from the woods but essentially the fur trade is in white foxes. Fox farming has been started at several points by the Hudson's Bay Company and promises to be a thriving industry if well managed. It will provide employment to the Eskimos in earing for them and looking after the fisheries which will furnish their chief food.

It is diffieult to arrive at an idea of the distribution of the wolves. They were scarce along the west coast of Hudson bay except at the northern extremity about Repulse bay. Nor are they numerous on the Arctic coast. From reports many wolves spend the winter near the edge of the woods at various points to the south and west of the open plains. It is probable that they breed in the

interior country in very scattered communities and gather in the fall at points where caribou or other game is abundant.

Fisheries.—There is an abundance of life in northern waters with a great range from primitive, simple forms to more advanced. Cod enter Hudson strait, though as far as is known they are not found in Hudson bay. There is a summer run, along the west coast of Hudson bay, of an excellent variety of salmon trout, the run lasting about two months.

SALMON TROUT OF HUDSON BAY

After the shore ice moves out from the west coast of Hudson bay a run of salmon trout comes to the coast northward from Churchill.

ESKIMOS DRYING FISH, HUDSON BAY COAST

Fish and seals furnish the staple summer food for the natives who live on the coast.

There has been little study given to the fisheries here but from observations made at Tavane and reports from points along the coast north of Churchill, this sea trout fishery may approximate the salmon run of the Pacific coast. The quality is excellent in these cold waters. A species of sardine on which the trout feed is very abundant, and the latter are fat and in good condition. These fisheries should support commercial operations either for canneries or for shipment, fresh, by the Hudson Bay Railway.

A good type of herring is found in certain localities and halibut were seen. It remains to be demonstrated what fish inhabit the deep waters of the bay. Seals, walruses, and white whales are numerous in these waters and occasional right whales are seen along the northern part of the coast.

Eskimos of Keewatin District

The only native inhabitants of Keewatin District are Eskimos. They are scattered in small bands throughout the area, each one having a recognized hunting range. The Arctic Eskimos keep principally to the vicinity of the coast in the west, but from Bathurst inlet eastward they at times move inland to join with their people in the Hudson Bay country. Between the Eskimo and the Indian who belongs to the southwesterly side of the height of land in the country drained by the Mackenzie river and its tributary waters, there is usually a wide belt of "no man's land." Between these two races there is a mutual distrust, partly based on traditional enmity and partly on the fact that these people are different temperamentally and that each feels a superiority over the other. The Eskimos as a people have won the respect and friendship of all who have lived among them. They are in general a cheerful, light-hearted people. They have met life successfully in a difficult country with a severe climate and show remarkable ingenuity in taking advantage of what their country offers, and foresight in providing for seasonal conditions. Their caribou clothing cannot be equalled by any other material as a protection against the cold and the garments are both tasteful and cleverly designed. In building the snow igloo and the kayak and in shaping their primitive spears and other implements of ivory, they make admirable use of what their country supplies. In hunting they are skilful, courageous, and persevering.

The tribal groups of the Eskimos are loosely organized and usually of a patriarchal nature. Families gather or scatter according to the seasonal food supply. There is little authority exercised by any among them. An old man or woman may be regarded as a conjuror and may be sought by others for assistance in the case of sickness or for advice in hunting, but they have little or no real control. Both the families and the tribal groups are to a large extent economic arrangements. In the family the man provides the food while the woman dresses the meat and skins and makes the clothing. She also prepares the food. The women have equal standing with the men and join the discussions concerning movements and general affairs. Family life is harmonious and great affection is shown to the children. Relationships are often involved, polygamy is common and children are frequently loaned and adopted. The Eskimos are not prolific. It is unusual to see more than two or three children in one family.

The people of the Hudson Bay coast appear to be in generally good health. There is comparatively little tuberculosis. The only systematic weakness noted is bronchial trouble which is probably caused by climatic conditions and it is spread by unsanitary habits in the igloo. In the past, life was extremely difficult for the aged and for those suffering from disease which prevented them from travelling. A station has been established by the Department of the Interior at Chesterfield to which a doctor will be attached. The Eskimos will receive assistance both in special cases of illness and by teaching them preventive measures, especially sanitation. The idea of scientific treatment is a new one to them and they cannot be trusted to take medicine except under observation. This lack of confidence will soon be overcome by a little education and by their own observations of resulting benefits.

The year cycle for Hudson Bay Eskimos has been little changed by the advent of white men. In the late summer they go inland in small groups to meet the caribou at traditional gathering places. The skins at this season are in good condition for clothing and the weather is sufficiently cold for the meat, put up in caches, to be well preserved. Supplies must be gathered to carry them over the lean period of the short days and the early winter. The caribou hunt occupies them until the snow is suitable for sleigh travel, some time in November. Then the scattered familites of the tribe gather together at some recognized meeting place where an igloo village is erected. During the

period of the short days they remain in their villages. The men set out their lines of fox traps and make trips to their meat caches. For the women the "taboo" which prohibits working with caribou skin before snow houses may be built, permits them now to prepare the skins and to make new clothes for the approaching cold weather. This is a season of comparatively easy times and general sociability. Formerly if they had been unsuccessful in the caribou hunt great hardship might result but now in such cases they fall back on the trading post.

As the days get longer with the returning sun they make more frequent hunting trips for caribou and carry on a certain amount of fishing through the ice on the inland lakes. Caribou and fish form their staple winter food. They

NATIVE TYPES, NORTHERN COAST

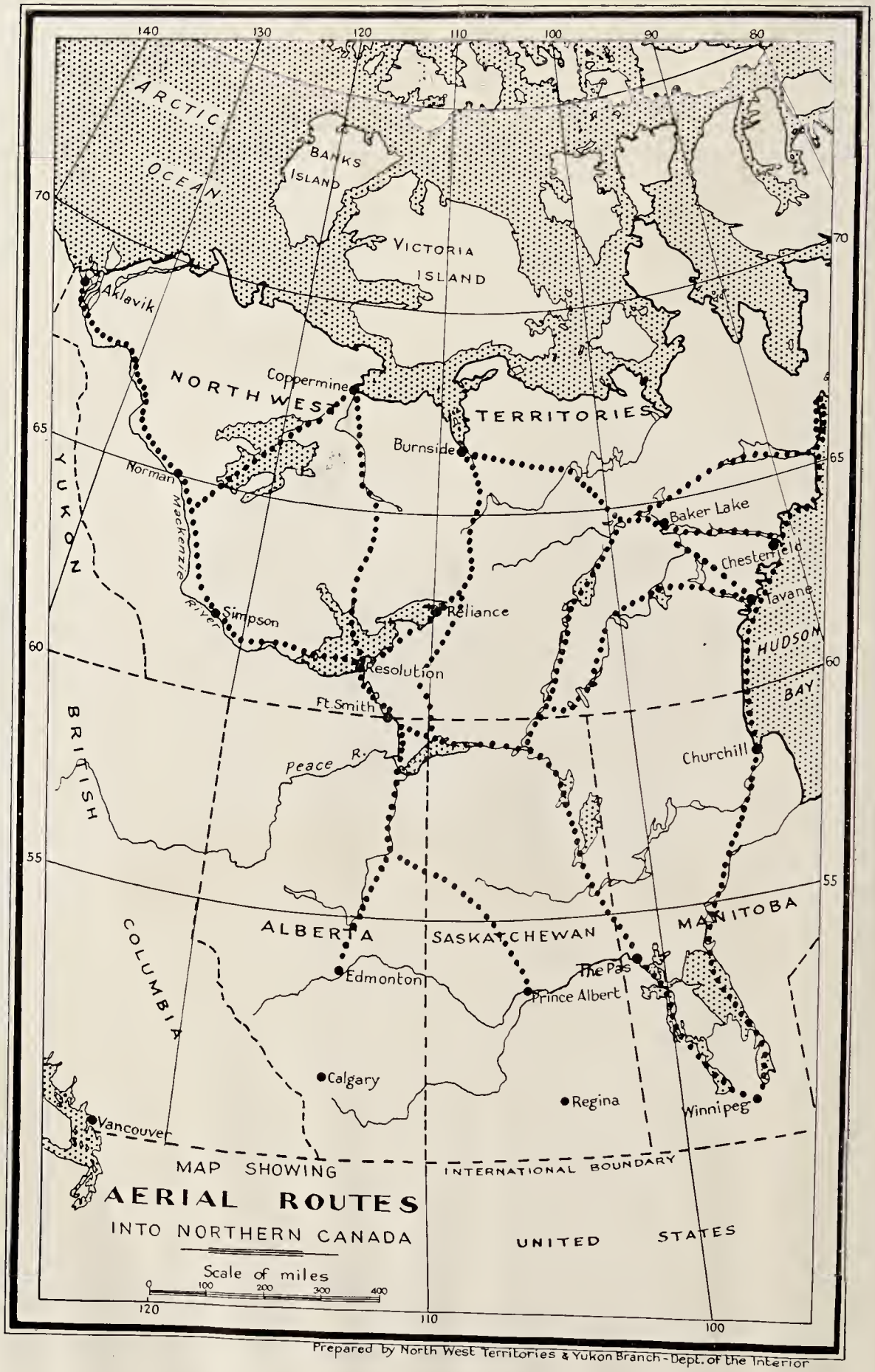
The Eskimos of the west coast wear their hair long, while on the Ungava side they cut it short.

do not move out on the ice for seals, as is done further north, until the very late spring when the snow has to a large extent melted from it. They then set their tents on points and islands near good sealing grounds where they remain, living on seal and fish until the ice has cleared from the coast.

Their annual visit to the trading post is made in midsummer and is usually timed to permit them to meet the supply steamer. They remain for a few weeks only, visiting with their relations and trading their fur. By this time caribou skins are again in good condition for clothing and once more they move back inland and scatter through their hunting ranges.

The Aeroplane and Northern Canada

Extensive use of the aeroplane has been made for some years in the country north of settlement. Great stretches of country have been mapped with the aid of the aerial camera. Forest lands have been investigated and patrolled and in many other ways development has been assisted by the use of the aeroplane for investigation and transportation. In the course of the aerial investigations in the Northwest Territories a new field was entered and



Prepared by North West Territories & Yukon Branch - Dept. of the Interior

new conditions were pioneered and several different types of aeroplanes were tested. Out of the experience conclusions can be drawn as to the possibilities and limitations of the aeroplane in the north.

Northern Canada is an excellent field in which to make practical use of the aeroplane. Great distances must be travelled and the time factor is always an important one. Then, too, the country itself is open to observation and lakes almost everywhere permit landing for closer study. These considerations played an important part in attracting those at present carrying on the mineral exploration of the country. They first had to be satisfied that the aeroplane could meet the conditions and perform the service before they would consider operations in a country so remote from settlement. From the best advice obtainable from those connected with aviation in Canada, plans were made and machines were selected.

From that time forward it was necessary to learn the conditions governing aviation in the Far North at the hard school of practical experience. Preparation must be sound and thorough and should be well in advance of operation, preferably the previous season in the case of gas caches. The most sturdily built plane available should be selected with an effective balance

NATIVE TYPES, SOUTHERN INTERIOR

The people of the interior are still very primitive. Their only contact with civilization is at the outposts of the traders. In winter they use only caribou skin clothing but for summer those of the traders have been adopted.

between pay load and gas consumption, and provision should be made for repairs and overhaul at the northern bases. But beyond the machine itself the most important consideration here, as for all northern work is that of the men operating them. Pilots in addition to being good aviators should be capable navigators and should be able to take care of themselves on the ground. Mechanics must be more than ordinarily resourceful and the safety factor and successful operation will depend largely on the skill and conscientiousness with which their work is performed. It was found in the work of the first season that a ground party was very much restricted in its operations without a canoe and during the following winter a canoe was designed and constructed to fit the bottom of the fusilage. In tests with the canoe strapped on, no difficulties were experienced and such canoes became part of the standard equipment carried by the planes for the field parties.

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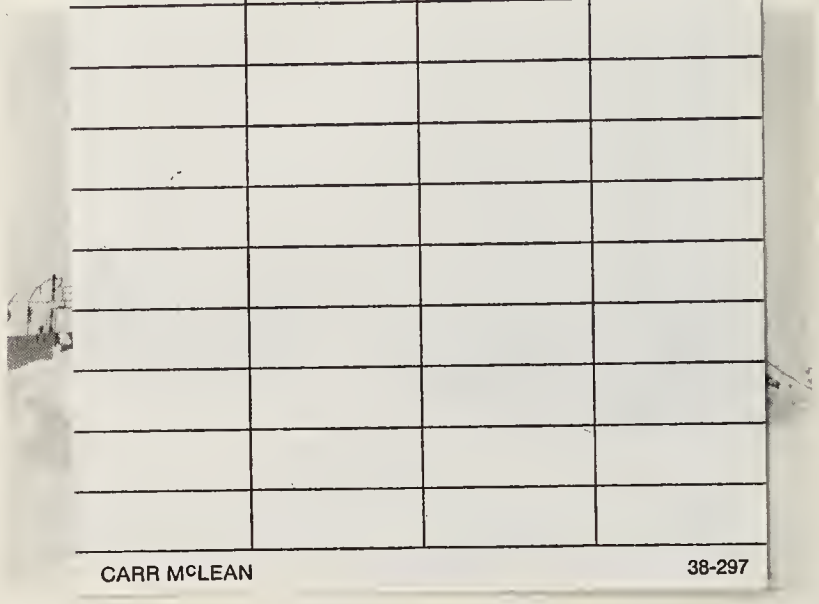

CHURCHILL—A WINTER VIEW IN THE HARBOUR
The various craft that wintered there were beached on the tidal flats and were undamaged by the disruption of the ice in the spring.

THE RAPID GROWTH DURING THE LONG DAYS OF JULY REACHES MATURITY IN EARLY AUGUST

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